

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In Re Patent Application of:	:	
Futoshi Tanigawa et al.	:	
	:	
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Appln. No.: 10/081,087	:	Examiner: Dah Wei Yuan
	:	
Filing Date: February 22, 2002	:	Attorney Docket No.: 10059-406US
	:	(P27064-01)
Title:	:	
	:	POSITIVE ELECTRODE ACTIVE MATERIAL FOR ALKALINE STORAGE
	:	BATTERY, POSITIVE ELECTRODE USING THE SAME AND METHOD OF
	:	PRODUCING THE SAME

**ON APPEAL FROM THE PRIMARY EXAMINER TO THE BOARD OF PATENT  
APPEALS AND INTERFERENCES**

**APPELLANT'S BRIEF UNDER 37 C.F.R. 41.37**

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## **I. REAL PARTY IN INTEREST**

This application is assigned to Matsushita Electric Industrial Co., Ltd. of Osaka, Japan, by an Assignment recorded on February 22, 2002, at Reel No. 012643, Frame 0300. Accordingly, Matsushita Electric Industrial Co., Ltd is the real party in interest.

## **II. RELATED APPEALS AND INTERFERENCES**

Appellants, their Assignee and their legal representatives are unaware of the existence of any related appeals and/or interferences that will directly affect, be directly affected by, or have a bearing on the decision in the pending appeal.

## **III. STATUS OF CLAIMS**

Claims 1-4 and 6-8 are pending in the instant application on appeal.

Claims 1-4 and 6-8 stand finally rejected as discussed below and are the subject of the instant appeal.

The complete text of claims 1-4 and 6-8, as pending, is attached hereto as Appendix A.

## **IV. STATUS OF AMENDMENTS**

All claim amendments have been entered.

## **V. SUMMARY OF CLAIMED SUBJECT MATTER**

The presently claimed invention relates to a positive electrode active material for an alkaline storage battery containing a nickel hydroxide powder and/or a nickel oxyhydroxide powder, in which the positive electrode active material exhibits particular physical properties, and a method of making a positive electrode using such a positive electrode active material. The positive electrode active material has a mean particle circularity of greater than 0.95 to less than 1, as determined by a particle image analysis with a flat sheath flow utilizing hydrodynamics, and the number of particles having a circularity of not larger than 0.85 accounts for not more than 5% of the total number of particles within the positive electrode active material (see, Appellants' Specification. ("Spec," page 9, lines 5-8).

The method of analysis which is used to measure mean particle circularity is critical for statistically distinguishing between very similar particle circularities. According to the presently claimed invention, circularity is determined using particle image analysis with a flat sheath flow

utilizing hydrodynamics. In this method, the images of most nickel hydroxide particles are captured and analyzed in real time to determine the circle equivalent diameter and particle circularity (Spec., page 12, line 20 to page 15, line 12). When particle analysis is not performed using the images of most of the nickel hydroxide particles, it is not possible to distinguish, for example, between the positive electrode active materials of Examples 2 and 3 (mean particle circularity 0.96-0.97) and the positive electrode active material of Comparative Example 1 (mean particle circularity 0.94).

The positive electrode active material according to the presently claimed invention also has a mean particle size from not smaller than 5  $\mu\text{m}$  to not larger than 20  $\mu\text{m}$  on a volume basis, and a specific surface area from not smaller than 5  $\text{m}^2/\text{g}$  to not larger than 20  $\text{m}^2/\text{g}$ , and the nickel hydroxide powder has an X-ray diffraction pattern in which a full width at half maximum of a peak attributed to (101) face is from not less than 0.7 deg/ $2\theta$  to not more than 1.2 deg/ $2\theta$ , and a ratio of a peak intensity of a peak attributed to (001) face to a peak intensity of a peak attributed to (101) face is not less than 1.1 (Spec, page 7, line 15 to page 8, line 3).

In one preferred embodiment, some or all of the positive electrode active material has a cobalt compound on its surface. In other embodiments, the nickel hydroxide or nickel oxyhydroxide powder contains solid solution nickel hydroxide or nickel oxyhydroxide containing Co, Cd, Zn, Mg, Ca, Sr, Ba, Al, and/or Mn (Spec., page 8, last 4 lines to page 9, line 4.)

The method for producing the positive electrode according to the invention involves preparing a paste containing the positive electrode active material, adding the paste to a metal substrate acting as a current collector, and rolling the substrate with the paste to form an electrode plate (Spec., page 9, last 5 lines to page 10, line 2).

When preparing the claimed active material, it is essential that the pH, stirring, and temperature of the raw material solutions be adjusted and carefully controlled in order to provide the desired circularity to the active material particles (Spec., page 17, lines 3-7; page 21, lines 6-8). Controlling circularity provides a positive electrode paste which exhibits stable properties, and the amounts of dispersion medium, thickener, etc. which must be added to the active material are reduced, resulting in an increased active material density in the electrode. Batteries having higher capacity and longer cycle life are also obtained (Spec., pages 15-16 and 33, Table 1).

In order to prepare a positive electrode active material having the high circularity and small variation in circularity exhibited by the present invention, it is necessary to vigorously stir the reaction solution in addition to controlling the temperature of the raw material solution. It takes at least several days and as long as several weeks to prepare spherical nickel hydroxide. Commercially, production facilities are operated consecutively and the temperatures of the raw material solutions vary with changes in ambient temperature during the operating period (e.g., differences between day and night temperatures and seasonal temperature changes throughout a year). Such variations in the temperatures of raw material solutions also affect the production rate and the amount of crystal nuclei produced, which change the physical properties of the resulting powders. Accordingly, even if the temperature of the reaction vessel is controlled, it is still important to control the temperature of the *raw material solution* and is essential in the Examples of the present application to maintain the raw material solution at a constant temperature.

Upon the addition of the raw material solution to the reaction solution, the following reactions occur successively: crystal nucleation, crystal growth, and the growth of a particle which is an aggregate of crystal nuclei. The shape and size of the crystal nuclei and those of the particle comprising the crystal nuclei are greatly affected by the temperature of the raw material solution and the speed at which the solution is stirred. This is because the crystal nucleation, the speed of crystal growth, and the growth direction of the crystal nuclei vary depending on the temperatures of the raw material solution and the reaction solution, the temperature difference between the raw material solution and the reaction solution, and the stirring speed.

Therefore, by controlling the temperature of the raw material solution, the variation in the shape and the size of the resulting crystal nuclei and particle will be extremely small. Further, it is impossible to produce particles having a circularity of not greater than 0.85 in an amount equal to not greater than 5% of the number of total particles in the active material without controlling the raw material solution at a constant temperature, even if the reaction solution is vigorously stirred.

The battery of Comparative Example 1, corresponding to prior art batteries, in which the temperatures of the raw material solutions are not adjusted when preparing the nickel hydroxide powder, exhibits a mean particle circularity of 0.94 and the number of particles having a circularity of not larger than 0.85 is 10%. In the battery of Example 2, corresponding to claim 1,

the mean particle circularity is 0.96 and the number of particles having a circularity of not larger than 0.85 is 5%. As shown in Table 1 of the Spec., the battery of Example 2 exhibits an improvement in battery capacity and capacity maintenance rate: the battery according to the invention has an increased capacity of 95 mAh, an increase in the percentage value  $C_{10A}/C_{0.4A} \times 100$  of 3%, and an increase in the capacity maintenance rate of 7%.

Considering the batteries of Example 1-3, it can be seen that as the number of particles having a circularity of not larger than 0.85 decreases, the battery capacity, the percentage value  $C_{10A}/C_{0.4A}$ , and the capacity maintenance rate improve. Specifically, comparing the battery of Example 1 (number of particles having a circularity not greater than 0.85 is 10%) to the battery of Example 2 (number of particles having a circularity not greater than 0.85 is 5%), the battery capacity decreases by 48 mAh, the percentage value  $C_{10A}/C_{0.4A}$  decreases by 1%, and the capacity maintenance rate decreases by 3%. Accordingly, reducing the percentage of particles having a circularity not greater than 0.85 from 10% to 5% has a significant effect on battery properties.

Further, comparing the battery of Example 1 to the battery of Example 3 (number of particles having a circularity not greater than 0.85 is 2.5%), the battery capacity decreases by 84 mAh, the percentage value  $C_{10A}/C_{0.4A}$  decreases by 2%, and the capacity maintenance rate decreases by 5%. This further demonstrates the significant effect of decreasing the percentage of particles having a circularity not greater than 0.85.

The technical field of alkaline storage batteries is quite advanced; many techniques and methods have been developed for achieving higher battery capacity. However, attempts have not conventionally been made to increase battery capacity by controlling the shapes of active materials. According to the presently claimed invention, however, by increasing the particle circularity and by decreasing the number of particles having a particle circularity of not larger than 0.85, i.e., by merely adjusting the shapes of the active material particles, the battery capacity, the percentage value  $C_{10A}/C_{0.4A}$ , and the capacity maintenance rate are improved.

## **VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

A. Claims 1-4 and 6-8 are rejected under 35 U.S.C. § 102(e) as being anticipated by or under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,358,648 of Hayashi et al. (“Hayashi”).

B. Claims 1-4 and 6-8 are rejected under 35 U.S.C. § 102(e) as being anticipated by or under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,083,642 of Kato et al. (“Kato”).

## **VII. ARGUMENT**

### **A. The Rejections of Claims 1-4 and 6-8 Under 35 U.S.C. § 102(e) or 103(a) as Anticipated by or Obvious over Hayashi are Improper**

#### **1. The Examiner’s Position**

In the Office Action mailed January 18, 2006 (hereinafter referred to as “final Office Action”), the Examiner maintains the rejection of claims 1-4 and 6-8 as being anticipated by or obvious over Hayashi for the same reasons set forth in previous Office Actions, and makes the rejection final.

In the final Office Action, the Examiner argues that regarding claims 1, 3, 4, 6, and 7, Hayashi teaches a nickel electrode active material for alkaline storage batteries comprising nickel hydroxide, which is allegedly produced by mixing and stirring an aqueous nickel sulfate solution and an aqueous sodium hydroxide solution. The Examiner argues that in the abstract and in col. 3, lines 51-67, col. 4, lines 39-51, and col. 6, lines 39-46, Hayashi teaches that the powders are subjected to alkali treatment with aqueous sodium hydroxide solutions having different pH values to remove anions, such as sulfate. The Examiner concludes that spherical powders (i.e., mean particle circularity equivalent to 1) of solid solute nickel hydroxide which incorporate one or two elements selected from cobalt, cadmium, zinc, and magnesium are produced, which have a mean particle size of about 10 microns. Hayashi allegedly also teaches that the resulting nickel hydroxide particles have better crystal growth and more homogeneous crystal growth along certain crystal planes than conventional nickel hydroxide, which the Examiner contends suggest uniform progress of the charge reaction of nickel hydroxide to nickel oxyhydroxide. Thus, the Examiner concludes that the positive electrode active material of Hayashi would invariably comprise nickel oxyhydroxide upon charging the battery.

The Examiner takes the position that the claimed properties, such as BET surface area, particle size distribution, and full width at half maximum of a particular crystallographic orientation, are inherent in the Hayashi material, given that the positive electrode active material disclosed by Hayashi and the present application have the same chemistry and manufacturing



procedures. The Examiner states that a reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. Citing *In re Robertson* (49 USPQ2d 1949 (1999)), the Examiner states that inherency is not established by probabilities or possibilities.

Alternatively, the Examiner argues that in Example 1, Hayashi teaches that nickel hydroxide is produced by mixing and stirring aqueous nickel sulfate and sodium hydroxide solutions. The Examiner takes the position that it is well known in the art that mixing and stirring enhance the uniformity of the multiple solutions in the mixture, and thus concludes that Hayashi would identify mixing (stirring) of the solution as a processing variable in the fabrication of positive electrode active material. Accordingly, the Examiner concludes that it would have been within the skill in the art to adjust the degree of mixing of the solution to yield nickel hydroxide or nickel oxyhydroxide powders of desired circularity and distribution of circularity. The Examiner cites *In re Bosch* (CCPA 1980, 617 F.2d 272, 205 USPQ 215) as stating that "discovery of optimum value of result effective variable in known process is ordinarily with skill of art."

Regarding claim 2, the Examiner argues that Hayashi teaches in col. 6, lines 37-46 that solid solution nickel hydroxide powders are produced by dissolving a sulfate of one or two elements, including cobalt, cadmium, zinc and magnesium, in the nickel sulfate solution. Accordingly, the Examiner concludes that the resulting positive electrode active material would have a cobalt compound on a portion of the surface.

Finally, regarding claim 8, the Examiner argues that Hayashi teaches in col. 5, lines 11-20 that positive electrode active material is first mixed with a cobalt powder, a cobalt hydroxide powder and a zinc oxide powder. Water is then added to the mixture and kneaded to make a paste, which is filled onto a foamed porous nickel substrate.

## **2. Appellants' Position**

### **a. The Examiner Has Ignored the Differences Between the Chemistry and Manufacturing Procedures of Hayashi and the Present Invention**

The chemistry and manufacturing procedures of Hayashi are not the same as in the present invention. According to the present invention, the pH of the aqueous alkaline solution to

which nickel and aqueous ammonia are added is maintained at a constant level, between 10 and 13. This pH level is maintained by adding aqueous alkaline solution during the production of nickel hydroxide (Spec., page 21, lines 6-13).

In contrast, in col. 3, lines 27-41, Hayashi describes the synthesis of nickel hydroxide via reaction of an aqueous nickel sulfate solution with an alkali. Once the nickel hydroxide has been formed, the remaining sulfate ion is removed by treatment with an aqueous alkaline solution.

Hayashi teaches that:

...the degree or extent of removal of the sulfate ion can be controlled by adjusting the pH of the aqueous alkaline solution used, and the duration and times of alkali treatment.

Hayashi thus does not teach or suggest that the pH of the reaction solution used to produce nickel hydroxide is adjusted, as in the present invention. Rather, the pH adjustment of Hayashi occurs after the nickel hydroxide has been formed in order to remove residual sulfate ion since a goal of the Hayashi method is to minimize the concentration of sulfate impurity in the nickel hydroxide.

Further, in Example 1, Hayashi teaches that,

Nickel hydroxide used in this example was produced by mixing and stirring an aqueous nickel sulfate solution and an aqueous sodium hydroxide solution thereby depositing nickel hydroxide (col. 4, lines 33-36).

In this example, the resulting nickel hydroxide materials were treated with aqueous sodium hydroxide solutions having different pH values to remove anions. However, there is no teaching or suggestion that in the synthesis of nickel hydroxide, mixing is a processing variable which was varied or optimized in any way, merely a teaching that the nickel sulfate and sodium hydroxide solutions were mixed and stirred to form nickel hydroxide. As explained in section V above, it is necessary to vigorously stir the solution in order to provide the inventive material, and vigorous stirring is not taught or suggested by Hayashi.

Finally, there is no teaching or suggestion in Hayashi of controlling the temperature of the raw material active solution as in the inventive method (Spec., page 24, lines 1-5). In fact, Hayashi is completely silent as to the temperature of the solutions used in the synthesis of nickel hydroxide. Therefore, the temperature of the solution in the Hayashi method depends solely on ambient temperature, which varies by such factors as location, the time of day and month of the

year. As explained in section V above, these variations are unacceptable in the inventive method because they lead to variations in the circularity of the resulting active material particles. Accordingly, Hayashi has not identified pH, degree of mixing/stirring, or temperature as critical processing parameters in the production of nickel hydroxide and thus the manufacturing procedures of Hayashi are different than in the present invention.

**b. The Active Material of Hayashi Would Not Inherently Exhibit the Claimed Properties**

The claimed mean particle circularity and distribution thereof of nickel hydroxide are critical to providing the effects of the presently claimed invention, but are only achieved by varying the pH, temperature, and stirring of the raw material solution, as described in Section V above. The Examiner argues in the final Office Action that the Hayashi materials would inherently exhibit the claimed properties, referring to *In re Robertson*. In *Robertson*, the Court stated:

To establish inherency, the extrinsic evidence ‘must make it clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill...Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.’

Necessity is thus the standard required for establishing a case of inherency, and the Examiner has the burden of providing evidence that the element at issue necessarily flows from the prior art reference. He cannot merely assume such information without supporting evidence. In other words, the Examiner must show that the inventive and Hayashi methods are similar enough that the resulting materials would necessarily exhibit the same properties.

The Examiner bases his conclusion on the assertion that the chemistry and manufacturing procedure of Hayashi is the same as in the present invention. To the contrary, since Hayashi does not teach the adjustment of pH, mixing, and temperature as in the present invention (see section VII.A.2.a. above), the Hayashi manufacturing procedure is not the same as in the present invention, and the claimed properties would not necessarily have been present in the Hayashi material. Accordingly, the Examiner has failed to establish a *prima facie* case of inherency in support of the anticipation rejection.

**c. There Would Have Been No Motivation Based on Hayashi to Adjust the Reaction Conditions to Arrive at the Claimed Material**

The Examiner contends that it would have been obvious to adjust the pH, temperature and stirring in the Hayashi method to arrive at the desired and claimed particle circularity and distribution. To the contrary, Hayashi does not recognize the parameters which needed optimization, particle circularity and circularity distribution, nor the profound effects such parameters would have on the resulting battery properties (see section VII.A.2.d. below). Therefore, one skilled in the art would not have been motivated to adjust the reaction conditions of Hayashi in order to arrive at the claimed positive electrode active material. Rather, such an assumption made by the Examiner is merely hindsight from the present invention, and the Examiner has not demonstrated any motivation to modify Hayashi to arrive at the claimed invention.

**d. The Uniqueness of the Claimed Particle Circularity and Circularity Distribution of the Active Material Provide Unexpected Properties and Rebut any Prima Facie Case of Obviousness**

A *prima facie* case of obviousness may be overcome by demonstrating that the claimed invention exhibits unexpected results (MPEP § 716). According to the presently claimed invention, the claimed active material has a mean particle circularity greater than 0.95, and the number of particles having a circularity of 0.85 or less accounts for not more than 5% of the total number. These features provide unique and unexpected results, as can be seen from Table 1 and Fig. 5 of the Spec.

For example, as set forth in section V above, comparing Example 1 (mean particle circularity 0.95, number of particles having a circularity of 0.85 or less is 10%) with Example 2 (mean particle circularity 0.96, number of particles having a circularity of 0.85 or less is 5%), the battery of Example 2 exhibits a 48mAh increase in battery capacity and a 3% improvement in capacity retention rate. These differences in characteristics are attributed to the fact that the mean particle circularity is greater than 0.95 in Example 2, and the particles having circularity less than 0.85 is 5%.

When the mean particle circularity is 0.95 or less, the ratio of particles having a small circularity is larger than that of Example 2. Thus, when the mean particle circularity is 0.95 or less, reducing the number of particles having a circularity of 0.85 or less has no effect on the

characteristics. It is only when the mean particle circularity is increased to greater than 0.95 and the number of particles having a circularity of 0.85 or less is controlled, that the improvements in characteristics can be achieved. In other words, the combination of the claimed mean circularity and circularity distribution produces the excellent and unexpected effects of the present invention.

In the production of the battery of Comparative Example 1 (corresponding to prior art batteries), processing variables are not optimized and the temperatures of the raw material solutions are not adjusted when preparing the nickel hydroxide powder. In comparison, the batteries of Examples 2 and 3 according to the present invention exhibit improved battery capacity and thus meet the objective of the present invention (Spec., page 10, lines 3-12). The mean particle circularities and distributions of these batteries are shown in the Table below. It can be seen that the batteries of Examples 2 and 3 exhibited improvements in battery capacity of 4.6% and 6.3%, respectively, relative to the comparative battery.

	mean particle circularity	# of particles with circularity $\leq 0.85$	battery capacity (C <sub>0.4A</sub> )	increase in battery capacity relative to Comp. Ex. 1
Comp. Ex. 1	0.94	10%	2058 mAh	-----
Ex. 2	0.96	5%	2153 mAh	4.6%
Ex. 3	0.97	2.5%	2189 mAh	6.3%

In the mature field of nickel-metal hydride storage batteries, there is little room for improvement in battery capacity. Therefore, Appellants' method, which provides for an increase in battery capacity by as much as 6.3% by optimizing reaction conditions to adjust the shapes of the active material particles to particular circularities, is in fact unexpected and significant and would not have been expected based on Hayashi. Thus, the presence of unexpected results, which is evidence of non-obviousness, has been demonstrated.

**B. The Rejections of Claims 1-4 and 6-8 Under 35 U.S.C. § 102(e) or 103(a) as Anticipated by or Obvious over Kato are Improper**

**1. The Examiner's Position**

In the final Office Action, the Examiner maintains the rejection of claims 1-4 and 6-8 as being anticipated by or obvious over Kato for the same reasons set forth in previous Office Actions, and makes the rejection final.

Regarding claims 1-4, 6 and 7, the Examiner argues that in the abstract, col. 4, lines 22-42 and line 66 to col. 5, line 5; col. 11, lines 50-65; col. 6, lines 39-46; col. 13, lines 26-45; and col. 29, lines 1-12, Kato discloses a positive electrode active material for an alkaline storage battery. The active material allegedly comprises nickel hydroxide particles and a higher cobalt oxide (gamma-cobalt oxyhydroxide). The positive electrode material is allegedly prepared by coating the surface of nickel hydroxide particles (a solid solution material with at least one metallic element such as cobalt, cadmium, and zinc) with the higher cobalt oxide to yield particles with an average particle diameter of 5 to 20 microns and a BET specific surface area of 5 to 12 m<sup>2</sup>/g. The Examiner argues that in one embodiment, Kato teaches that an aqueous solution containing nickel sulfate as the main component, cobalt sulfate, and zinc sulfate are mixed. An aqueous sodium hydroxide solution is slowly added dropwise while adjusting the pH of the solution with aqueous ammonia, thereby depositing spherical solid solution nickel hydroxide particles (i.e., the circularity of the particles is 1). Kato allegedly teaches that the resulting solid solution nickel hydroxide particles with Co and Zn incorporated therein are washed with water and then dried to obtain positive electrode particles. The Examiner also contends that Kato reveals the presence of nickel oxyhydroxide in the positive electrode active material based on the X-ray diffraction and spectral calorimeter studies.

Again citing *In re Robertson*, the Examiner takes the position that the claimed properties, such as particle size distribution and full width at half maximum of a particular crystallographic orientation, are inherent in the Kato material given that the positive electrode active material disclosed by Kato and the present application have the same chemistry and manufacturing procedures.

Alternatively, the Examiner argues that in col. 2, lines 15-45; col. 3, lines 25-50; col. 4, lines 38-61, and Example 2, Kato has identified pH and temperature of the solution as critical processing variables in the fabrication of positive electrode active materials. Therefore, the Examiner concludes that it would have been within the skill in the art to adjust the pH of the solution to yield nickel hydroxide or oxyhydroxide of desired circularity and distribution of circularity. The Examiner again takes the position that it is well known in the art that mixing and stirring enhance the uniformity of the multiple solutions in the mixture, and thus concludes that Kato would identify mixing (stirring) of the solution as a processing variable in the fabrication of positive electrode active material. Again citing *In re Bosch*, the Examiner concludes that it would have been within the skill in the art to adjust the degree of mixing of the solution to yield nickel hydroxide or nickel oxyhydroxide powders of desired circularity and distribution of circularity.

Regarding claim 8, the Examiner argues that Kato teaches in col. 11, line 66 to col. 12, line 10 that positive electrode active material is first mixed with a cobalt powder, a cobalt hydroxide powder, and a zinc oxide powder. Water is then added to the mixture and kneaded to make a paste, which is filled into a foamed porous nickel substrate.

## **2. Appellants' Position**

### **a. The Examiner Has Ignored the Differences Between the Chemistry and Manufacturing Procedures of Kato and the Present Invention**

The chemistry and manufacturing procedures of Kato are not the same as in the present invention. As explained in section VII.A.2.a. above, the pH of the aqueous alkaline solution to which nickel and aqueous ammonia are added is maintained at a constant level, between 10 and 13. This pH level is maintained by adding aqueous alkaline solution during the production of nickel hydroxide.

In Example 2, Kato indeed teaches pH and temperature of the solution to be important. However, these parameters are taught to be critical in the production of cobalt hydroxide serving as a conductive agent, not in the production of nickel hydroxide, as in the present invention. Kato teaches in Example 2 that nickel hydroxide particles were charged in an aqueous cobalt sulfate solution and an aqueous sodium hydroxide solution was added dropwise with stirring while adjusting the pH at 35°C to pH 12. However, this Example of Kato which is relied upon by the

Examiner in the rejection describes the preparation of Co(OH)<sub>2</sub>-coated nickel hydroxide particles, and not the synthesis of the nickel hydroxide particles themselves. These nickel hydroxide particles were prepared in Example 1, which describes the addition of sodium hydroxide to an aqueous solution of nickel sulfate, cobalt sulfate, and zinc sulfate while adjusting the pH with aqueous ammonia. However, Kato does not disclose any detailed reaction conditions in the production method of nickel hydroxide, such as the temperature or appropriate pH, nor does Kato suggest that such parameters are critical to the production method, despite the Examiner's contention to the contrary. Therefore, Kato does not teach the criticality of temperature and pH in the production of nickel hydroxide, and thus the chemistry and manufacturing procedures of Kato are different than in the present invention.

**b. The Active Material of Kato Would Not Inherently Exhibit the Claimed Properties**

The claimed mean particle circularity and distribution thereof of nickel hydroxide are critical to providing the effects of the presently claimed invention, but are only achieved by varying the pH, temperature, and stirring of the raw material solution, as described above. As explained in section VII.A.2.b. above, necessity is the standard required for establishing a case of inherency, and the Examiner has the burden of providing evidence that the element at issue necessarily flows from the prior art reference. He cannot merely assume such information without supporting evidence. In other words, the Examiner must show that the inventive and Kato methods are similar enough that the resulting materials would necessarily exhibit the same properties.

Here, the Examiner bases his conclusion on the assertion that the chemistry and manufacturing procedure of Kato is the same as in the present invention. To the contrary, since Kato does not teach the adjustment of pH, mixing, and temperature as in the present invention (see VII.B.2.a. above), the Kato manufacturing procedure is not the same as in the present invention, and the claimed properties would not necessarily have been present in the Kato material. Accordingly, the Examiner has failed to establish a prima facie case of inherency in support of the anticipation rejection.



**c. There Would Have Been No Motivation Based on Kato to Adjust the Reaction Conditions to Arrive at the Claimed Material**

The Examiner contends that it would have been obvious to adjust the pH, temperature and stirring in the Kato method to arrive at the desired and claimed particle circularity and distribution. To the contrary, Kato does not recognize the parameters which needed optimization, particle circularity and circularity distribution, nor the profound effects such parameters would have on the resulting battery properties (see VII.A.2.d.). Therefore, one skilled in the art would not have been motivated to adjust the reaction conditions of Kato in order to arrive at the claimed positive electrode active material. Rather, such an assumption made by the Examiner is merely hindsight from the present invention, and the Examiner has not demonstrated any motivation to modify Kato to arrive at the claimed invention.

**d. The Uniqueness of the Claimed Particle Circularity and Circularity Distribution of the Active Material Provides Unexpected Properties and Rebuts any Prima Facie Case of Obviousness**

The unexpected results of the presently claimed invention were shown in section VII.A.2.d. above. These results have shown that Appellants' method, which provides for an increase in battery capacity by as much as 6.3% by optimizing reaction conditions to adjust the shapes of the active material particles to particular circularities, is in fact unexpected and significant and would not have been expected based on Kato. Thus, the presence of unexpected results, which is evidence of non-obviousness, has been demonstrated.

### VIII. CONCLUSION

For the reasons set forth above, Appellants respectfully submit that pending claims 1-4 and 6-8 are patentable over the prior art cited by the Examiner. Reversal of the rejections and issuance of a Notice of Allowance are respectfully requested at the earliest opportunity.

Respectfully submitted,

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Attachments: Appendix A- Claims Appendix

Appendix B- Evidence Appendix

Appendix C – Related Appeals and Interferences Appendix

## **APPENDIX A: CLAIMS APPENDIX**

1. A positive electrode active material for an alkaline storage battery comprising: at least one selected from the group consisting of a nickel hydroxide powder and a nickel oxyhydroxide powder,

(1) wherein said positive electrode active material has a mean particle circularity from greater than 0.95 to less than 1 as determined by a particle image analysis with a flat sheath flow utilizing hydrodynamics and wherein the number of particles having a circularity of not larger than 0.85 accounts for not more than 5% of the number of total particles within said positive electrode active material,

(2) said positive electrode active material has a mean particle size from not smaller than 5  $\mu\text{m}$  to not larger than 20  $\mu\text{m}$  on a volume basis,

(3) said positive electrode active material has a specific surface area from not smaller than 5  $\text{m}^2/\text{g}$  to not larger than 20  $\text{m}^2/\text{g}$ , and

(4) at least said nickel hydroxide powder has an X-ray diffraction pattern where a full width at half maximum of a peak attributed to (101) face is from not less than 0.7 deg/2 $\theta$  to not more than 1.2 deg/2 $\theta$  and a ratio of a peak intensity of a peak attributed to (001) face to a peak intensity of a peak attributed to (101) face is not less than 1.1.

2. The positive electrode active material for an alkaline storage battery in accordance with claim 1, wherein the whole or a portion of said positive electrode active material has a cobalt compound on a surface of said positive electrode active material.

3. The positive electrode active material for an alkaline storage battery in accordance with claim 1, wherein said nickel hydroxide powder comprises a solid solution nickel hydroxide containing at least one selected from the group consisting of Co, Cd, Zn, Mg, Ca, Sr, Ba, Al and Mn.

4. The positive electrode active material for an alkaline storage battery in accordance with claim 1, wherein said nickel oxyhydroxide powder comprises a solid solution nickel oxyhydroxide containing at least one selected from the group consisting of Co, Cd, Zn, Mg, Ca,

Sr, Ba, Al and Mn.

6. The positive electrode active material for an alkaline storage battery in accordance with claim 1, wherein, in a volume basis size distribution of the particles in said positive electrode active material, the particle size coordinate is not smaller than one-third of said mean particle size at a point where a cumulative volume accounts for 10% of a total volume of the particles.

7. A positive electrode for an alkaline storage battery including the positive electrode active material in accordance with claim 1.

8. A method of producing a positive electrode for an alkaline storage battery comprising the steps of:

(a) preparing a paste containing a positive electrode active material; and (b) adding said paste to a metal substrate serving as a current collector and then rolling said substrate with said paste to form an electrode plate,

(1) wherein said positive electrode active material comprises at least one selected from the group consisting of a nickel hydroxide powder and a nickel oxyhydroxide powder,

(2) said positive electrode active material has a mean particle circularity from greater than 0.95 to less than 1 as determined by a particle image analysis with a flat sheath flow utilizing hydrodynamics and wherein the number of particles having a circularity of not larger than 0.85 accounts for not more than 5% of the number of total particles within said positive electrode active material,

(3) said positive electrode active material has a mean particle size from not smaller than 5  $\mu\text{m}$  to not larger than 20  $\mu\text{m}$  on a volume basis,

(4) said positive electrode active material has a specific surface area from not smaller than 5  $\text{m}^2/\text{g}$  to not larger than 20  $\text{m}^2/\text{g}$ , and

(5) at least said nickel hydroxide powder has an X-ray diffraction pattern where a full width at half maximum of a peak attributed to (101) face is from not less than 0.7 deg/ $2\theta$  to not more than 1.2 deg/ $\theta$  and a ratio of a peak intensity of a peak attributed to (001) face to a peak intensity of a peak attributed to (101) face is not less than 1.1.

## **APPENDIX B: EVIDENCE APPENDIX**

No evidence has been relied upon.

## **APPENDIX C: RELATED APPEALS AND INTERFERENCES APPENDIX**

None.